Two-dimensional spectra of sea level variations derived from Topex/Poseidon data

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One of the most conspicuous features of oceanic fields is their intrinsic statistical anisotropy and multiple-scale variability. We present first results of statistical analysis of the two-dimensional field of sea surface height (SSH) variations in a range of scales from 70 to 1000 km. This study has become possible due to a relatively high accuracy of SSH determination achieved in the Topex/Poseidon project and due to a special technique of spectral analysis developed here for altimeter data. The large distance between satellite ground tracks (about 220 km near the equator) and inclination of the Topex orbit complicate transfer of SSH data to a regular sufficiently fine grid which would be adequate for application of standard (FFT-based) techniques. The highest wave numbers that can be resolved based on the usual techniques would be at best about 0.01 rad/km. Taking into account great importance of shorter scales, this limitation is very severe. The approach developed in the present work is based on the use of the structure function. This allows us to use original (i.e., not gridded) data, to alleviate effects of statistical spatial inhomogeneity of the SSH field, and to dramatically increase the spatial resolution of SSH spectral analysis.

Our main results include two-dimensional wavenumber spectra of SSH spatial variations estimated for several ocean areas 10 by 10 degree in size, The spectra reveal latitudinal dependence of the angular orientation of spectral peaks associated with the direction of wave propagation and with geometry of mesoscale features. Other interesting findings include the presence of several "wave" systems in some regions. Such systems would be indistinguishable in 1-d spectra based on individual satellite tracks.

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